CONTRACT INSPECTION REPORT

CONTRACT NO.

TASK NO. 4

25X1

TO:

ENGINEERING SECTION/CB/PD/OL

DATE 12 August 1965

INSPECTION REPORT NO. *(If final, so state)* 1

ESTIMATED COMPLETION DATE 22 July 1966

NAME

TYPE OF COMMODITY OR SERVICE

Spatial Frequency Analyzer Feasibility Study

Declass Review by NGA.

THE CONTRACTOR IS ON SCHEDULE ☒ YES ☐ NO

PER CENT OF WORK COMPLETED - 01%

PER CENT OF FUNDS EXPENDED - 01%

THE CONTRACTOR WILL PROBABLY REMAIN WITHIN ALLOCATED FUNDS ☒ YES ☐ NO IF ANSWER IS "NO" ADVISE RECOMMENDATION AND/OR ACTION OF SPONSORING OFFICE, ON REVERSE HEREOF. IF KNOWN, INDICATE MAGNITUDE OF ADDITIONAL FUNDS INVOLVED.

HAS AN INTERIM REPORT, FINAL REPORT, PROTOTYPE, OR OTHER END ITEM BEEN RECEIVED FROM THE CONTRACTOR DURING THE PERIOD? ☐ YES ☒ NO *(If yes, give details on reverse side.)*

HAS GOVERNMENT-OWNED PROPERTY BEEN DELIVERED TO CONTRACTOR DURING THIS PERIOD? ☐ YES ☒ NO *(If yes, indicate items, quantity, and cost on reverse side.)*

INCENTIVES

IS THIS AN INCENTIVE CONTRACT ☐ YES ☒ NO

IF YES, CHECK TYPE ☐ COST ☐ PERFORMANCE ☐ DELIVERY

NOTE:
USE REVERSE SIDE FOR COMMENTS.
FINAL REPORT MUST CONTAIN INCENTIVE EVALUATION.

OVERALL PERFORMANCE OF CONTRACTOR

1. ☐ OUTSTANDING
2. ☐ EXCELLENT
3. ☐ ABOVE AVERAGE
4. ☒ AVERAGE
5. ☐ BELOW AVERAGE
6. ☐ BARELY ADEQUATE
7. ☐ UNSATISFACTORY

IF OVERALL PERFORMANCE OF CONTRACTOR IS UNSATISFACTORY OR BARELY ADEQUATE, INDICATE REASONS ON REVERSE SIDE.

RECOMMENDED ACTION

☒ CONTINUE AS PROGRAMMED

☐ WITHHOLD PAYMENT PENDING SATISFACTORY PERFORMANCE

☐ TERMINATE

☐ OTHER *(Specify)*

IF TERMINATION IS RECOMMENDED OR IF THIS IS A FINAL REPORT PUT COMMENTS ON REVERSE IN NARRATIVE FORM ON CONTRACTOR'S PERFORMANCE AND CERTIFY THAT ALL DELIVERABLE ITEMS UNDER THE CONTRACT HAVE BEEN RECEIVED. THESE INCLUDE, WHERE APPLICABLE, THE FOLLOWING:

ITEM	REC'D	DOES NOT APPLY	ITEM	REC'D	DOES NOT APPLY
PROTOTYPES			MANUALS		
DRAWINGS AND SPECIFICATIONS			FINAL REPORT		
PRODUCTION AND/OR OTHER END ITEMS			SPECIAL TOOLING		
			OTHER GOVERNMENT PROPERTY		

DATE OF LAST CONTACT WITH CONTRACTOR 8 July 1965

SIGNATURE OF INSPECTOR

DIVISION P & D S

INSPE

SIGNATURE OF APPROVER

NARRATIVE REPORT ☒ INTERIM ☐ FINAL

This study is tied in very closely with the Image Perceptibility Study and is dependent on some of the equipment used in it. Most of the actual work will not be started until December 1965 or later when the Image Perceptibility Study is well underway.

Approved For Release 2005/02/17 : CIA-RDP78B04770A000100100012-8

EPT and Modulated Light Table Programs Reviews

February 8, 1966

Minutes

A review of the EPT program was conducted at [redacted] on February 8, 1966. 25X1
Both technical and financial status and plans were presented in detail and discussed with the customer. A brief review of these two items for the Modulated Light Table Program was also given and discussed at the same meeting. 25X1
An agenda of the items discussed is attached. In attendance were:

[redacted]

25X1 The [redacted] personnel presented their summaries of the different tasks, as indicated in the agenda, using both specially prepared briefing charts as well as the standard financial and milestone progress charts used in [redacted] Management 25X1 reviews of each project. Copies of those charts dealing with financial matters are attached to this memorandum.

A number of specific points and questions were raised at the meeting that should be noted. For the EPT Program, only, total direct current costs were presented on the charts. When R.N. requested a further breakdown of these figures, estimates were given for the contact printer - current, [redacted] anticipated final, 25X1
25X1 [redacted] the electro-chemical processing techniques - current, for labor and materials
25X1 equipment [redacted] and electronic processing techniques and analysis - current, The remainder is for publications.

For the EPT program electrical-chemical processing analysis, R.N. indicated
25X1 he did not want [redacted] to emphasize the use of photo-copy techniques, but rather modulated light, chemical, and spatial filtering techniques. [redacted] questioned 25X1
R.N. on the availability of actual scenes to be supplied to [redacted] for use in develop- 25X1
ing and evaluating processing techniques. R.N. indicated that [redacted] should use 25X1
selected samples from the roll of film supplied to [redacted] It was agreed that the 25X1
government representatives would select samples to be processed and also the areas within these pictures that needed improvement. This was done later in the day when 11 scenes were selected. However, it was indicated that [redacted] could 25X1
choose other scenes and areas in them, if he felt he could significantly improve them with his techniques. R.N. said it was more important that [redacted] work on those 25X1

films which were good samples of operational pictures than on artificially generated targets or degraded versions of them. He said that [ ] should hence- 25X1
forth concentrate on the scenes from the film roll rather than the target-scene combination which had been generated in accordance with previous Government direction.

With respect to the contact printer, R.N. questioned whether the design goals for this item had been specifically agreed on prior to its development. He indicated he felt the objectives of the [ ] design, in particular how this 25X1
printer compared to existing modulated light printers, were not clear. [ ] 25X1
indicated that the printer was designed to provide high resolution capability which at the time of design were not believed to exist in other printers.
25X1 [ ] indicated that 200 cycles/mm had been measured for the printer and that further measurements would be made to see if higher resolution could be obtained on other films. R.N. suggested that a comparison should be made with the published capabilities of the Log E printers using 8430 film for the measure-
ments. G.M. will obtain resolution targets for [ ] to make its measurements. 25X1
25X1 [ ] pointed out other features that the [ ] printer had that were not 25X1
25X1 believed to be in the [ ] printer (e.g., more sophisticated box scan, smaller spot size, automatic exposure control with integral scanning fields). It was agreed by all, however, that the purpose of the printer development was to provide a simple, high resolution, bread-boarded tool for electrophotographic processing technique experiments and that the device was not to be considered as an optimized, production model for delivery to the customer and operational use.

A review of mathematical techniques being used in analyzing the effects of electronic processing was given by [ ] D.L. indicated that the approach 25X1
was consistent with the techniques of other investigators. [ ] then related 25X1
this mathematical description of the processing to the two breadboards being built on this program to test the electronic processing techniques. Samples of processing using the first breadboard were displayed. R.N. indicated a desire to receive positive prints of the original, the output of the printer using no modulation, and the output with modulation. These are to be used for measurements.
25X1 [ ] agreed to provide such prints.

Brief summaries were given of plans to use photo-interpreter consultants, to perform a rear projection viewer study, and to develop a spatial frequency
25X1 analyzer. R.N. indicated that [ ] should not start work on any of these items until further direction was received from the customer.

R.N. also requested a further breakdown of EPT costs by tasks, manpower, and materials. He indicated that he would supply a list of the items of information desired.

A review was made of the status of the modulated light viewing table program. 25X1 [ ] indicated an anticipated final direct cost of [ ] with Prototype #1 being completed by March 11 and Prototype #2 by April 5. This final cost represents an overrun of [ ] above the budgeted contract cost plus the [ ] had agreed to absorb. R.N. indicated that these costs would have to be reviewed and a decision as to further action would be made by the customer by February 11. He advised [ ] to continue on its present work schedule, but not to make any new commitments until direction was received from the customer.

In answer to [ ] request for comment on [ ] summary of the January 6 meeting on the viewing tables, R.N. said that he thought the minutes were essentially accurate.

A summary of action items arising as a result of the meeting is as follows:

1. The customer is to inform [ ] as to what further steps to take with respect to
   a) Rear Projection Viewer Study
   b) Use of Photo-Interpreter Consultants
   c) Spatial Frequency Analyzer Development
2. The customer will supply a list of information desired for the EPT program cost breakdown.
3. The customer will provide targets for resolution measurements to be made on the contact printer.
4. The customer will review the financial status of the Modulated Light Viewer program and make recommendations for new actions or changes.
5. [ ] will supply EPT program cost breakdown after receiving list of desired information.
6. [ ] will provide positive prints of the inputs to, plus unmod. and mod. outputs of first breadboard developed during electronic processing study on EPT.
7. [ ] will determine if cost reductions can be made on the Modulated Light Viewer program and will advise customer of the extent and effects of such reductions.

25X1 8. [redacted] promised to re-evaluate R.N.'s suggested modification of the viewing table pantagraph (arm).

25X1 [redacted]

Government Approval

EPT Program Review

February 8, 1966

AGENDA

25X1 Introduction - [redacted]

Program Goals

Overall Program Schedule (Standard Charts)

Program Funding Status

Analytical Basis for Processing Techniques - [redacted] 25X1

Electrical-Chemical Processing - [redacted] 25X1

Modulated Light Contact Printer

Electronic Processing Techniques

Qualitative Picture Evaluation - [redacted] 25X1

Rear View Projector Proposal - [redacted] 25X1

Image Spatial Frequency Analyzer - [redacted] 25X1

Modulated Light Viewing Table - [redacted] 25X1

Electrical-Chemical Processing Techniques
Demonstration - Laboratory - [redacted] 25X1

Modulated Light Printer Display - Laboratory or
25X1 Conference Room - [redacted]

Next 4 Page(s) In Document Exempt

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25X1

[redacted]

ELECTROPHOTOGRAPHIC PROCESSING TECHNIQUES

25X1 CONTRACT [redacted] TASK ORDER NO. 03(100,762)65-R

Monthly Narrative Report - August 1965

This is the second of a series of monthly narrative reports on a study of electrophotographic processing techniques. The study comprises the investigation and development of photographic and electronic techniques for processing photographic images. This report covers the work performed by the [redacted] during the period from 22 July to 22 August 1965. (Project personnel participated in a two-week Division shutdown for vacation ending 1 August 1965.)

25X1

25X1

A. Current Status of Work

1. Photographic Processing. The key to photographic processing will be control of acutance and granularity by adjustment of density thresholds, expansion and contraction of densities, and variation of the illuminating spot from a modulated-light source. Most of the special test equipment required to perform these tasks was delivered. Also, construction of the new photographic laboratory was nearly completed. The improved facilities are expected to be operational by the end of August.

A schedule for calibrating the special test equipment has been prepared. Standardization is required to properly relate the findings of this study to the photographic community. The effort will call upon the pertinent experience of the National Bureau of Standards.

The development of the modulated-light contact printer is proceeding satisfactorily. The design is essentially completed and most of the parts have been ordered. The printer will operate in a vertical

configuration with the kinescope at the bottom and the observation or set-up screen at eye level. Most of the elements of the system (e.g., lenses, film press, and partially-reflecting mirror) will be movable along a column adapted from a standard drill press.

2. Electronic Processing. The key to electronic processing, analogous to photographic processing, will be separate and simultaneous operation on the high and low frequency information in the photographic images. Breadboard equipment to evaluate critical aspects of the proposed high-resolution processing system has been assembled and operated.

Preliminary tests have shown the two-kinescope system to be stable. In application of the principle of color separation, the sensing light (3750 Å) passes through the transparency and to the multiplier phototube through a filter which effectively removes the modulated yellow light (5700 Å). Thus, either a positive or negative light mask may be registered with the transparency without system oscillation--over a bandwidth from dc to 20 megacycles and with full system gain.

Light measurements were made with unexposed film in contact with a transparency. Seven types of Kodak film, including some made without the usual anti-halation backing, were tested. Type No. 2427 produced the least attenuation at 3750 Å, but the system did not yield a fully-modulated picture. Apparently, more light or higher gain is needed.

B. Problem Areas Encountered

1. Photographic Processing. Assistance is required in obtaining GEMS (Graded Estimated Measuring Samples) for image quality determinations and Edge-GEMS for edge gradient measurements. The desired GEM parameters must still be specified.

2. Electronic Processing. In order to obtain a fully-modulated picture with the proposed electronic processing system, either more light or higher gain is needed. The latter may be achieved with a 15-stage multiplier phototube driving a lower-noise amplifier input stage (e.g., a cascoded stage).

C. Projected Work for Next Monthly Period

1. Photographic Processing

a. Calibration of special test equipment.

b. Continued investigation of the intensity/density properties of preselected films.

c. Experimental determination of the intensity/density properties of the ten film chips provided by the Technical Representative of the Contracting Officer.

d. Preliminary processing of the film chips.

e. Specification of desired GEM and Edge-GEM parameters.

f. Continued development (completed construction) of the modulated-light contact printer.

2. Electronic Processing

a. Continued measurement of the light characteristics of the breadboard system.

b. Modification of system components (e.g., the feedback amplifier).

c. Continued design of the high-resolution electronic processing system.

D. Status of Fund Expenditures to End of Monthly Period

Funds expended at break-even level to 29 August 1965:

25X1

E. Documentation of Verbal Committments and/or Agreements During the Period

1. Desired GEM and Edge-GEM parameters will be specified by the end of the next monthly period.

2. The Technical Representative will attempt to facilitate exchanges of pertinent information between project personnel and various members of the photographic community (including the National Bureau of Standards).

25X1

[redacted]

ELECTROPHOTOGRAPHIC PROCESSING TECHNIQUES

25X1 CONTRACT [redacted] TASK ORDER NO. 03(100,762)65-R

This is the third of a series of monthly narrative reports on a study of electrophotographic processing techniques. The study comprises the investigation and development of photographic and electronic techniques for processing photographic images. This report covers the work performed by

25X1 the [redacted] during the period from 22 August to 22 September 1965.

A. Current Status of Work

1. Photographic Processing

The key to photographic processing will be control of acutance and granularity by adjustment of density thresholds, expansion and contraction of densities, and variation of the illuminating spot from a modulated-light source. Most of the special test equipment required to perform these tasks has been received and installed in the new photographic laboratory. These improved facilities are now operational.

Calibration of the test equipment has begun with the microdensitometer, isodensitracer, and microscope photometer. This phase of the study is required to reproduce experimental results and to properly relate the findings to the photographic community. The effort will continue to call upon the pertinent experience of the National Bureau of Standards.

Construction of the modulated-light contact printer is nearly complete. Most of the electronic components are assembled on a standard equipment rack. The kinescope yoke driver and its associated power supply have not yet been received from the manufacturer. Also, the exposure control counter, whose modification was necessitated by a change from phase-locked to crystal-controlled master oscillators, is still not completed. Delivery of the modulated-light contact printer to the photographic laboratory should occur before the end of the next monthly period.

Densitometry/microdensitometry and GEMS/Edge-GEMS were the subjects of useful discussions between project personnel and technical representatives of the Contracting Officer and the National Bureau of Standards. These talks are expected to aid in the calibration of photographic materials and equipment. Further exchanges of information with members of the photographic community are planned for the future.

2. Electronic Processing

The key to electronic processing, analogous to photographic processing, will be separate and simultaneous operation on the high and low frequency information in the photographic images. Breadboard equipment to evaluate critical aspects and demonstrate operating principles of the proposed two-kinescope processing system has been assembled and operated. Orderly modifications of the equipment are being made as required.

An improved multiplier phototube [redacted] and circuit have been incorporated into the breadboard system. Signal-to-noise ratios of

25X1

15-25 db have been obtained with the flying-spot scanner, a transparency of average density, and undeveloped film in contact with the transparency. Best results were obtained with type SO-3404 film; type SO-2427 film produced the lowest signal-to-noise ratios. The system exhibits a flat video characteristic to 20 megacycles per second and maintains stability with full amplifier gain.

Feasibility of the proposed electronic processing system having been demonstrated, two [redacted] high-resolution kinescopes and associated mounts, coils, yokes, and yoke drivers were ordered. The [redacted] tubes should be delivered within four months. (This delay was incorporated into the original program schedule.) The present breadboard system can provide useful results until that time; the coarse-spot kinescopes are compatible with test GEMS, whose maximum resolution is of the order of 25 cycles per millimeter.

25X1

25X1

B. Problem Areas Encountered

1. Photographic Processing

a. Some delays in delivery of special test equipment are being experienced. Efforts to speed-up delivery of the Dekagon micro-copy camera are being pursued.

b. Electric power line fluctuations are being reflected in density and transmittance measurements. Additional power regulation will have to be provided in the photographic laboratory (during the next monthly period).

2. Electronic Processing

While a signal-to-noise ratio of 25 db is sufficient for most television applications, it may not be adequate to perform some of the

proposed electronic processing (e.g., high-frequency peaking). Experiments will be performed to resolve this problem.

C. Projected Work for Next Monthly Period

1. Photographic Processing

a. Continue calibration of the special test equipment.

b. Continue investigations of the intensity/density properties of preselected films and available film chips.

c. Continue investigation of GEM and Edge-GEM parameters and uses.

d. Complete construction of the modulated-light contact printer.

2. Electronic Processing

a. Continue measurement of the breadboard system characteristics.

b. Perform system modifications as required.

c. Continue design of the high-resolution electronic processing system.

Preparation of the First Interim Technical Report will be completed during the next monthly period.

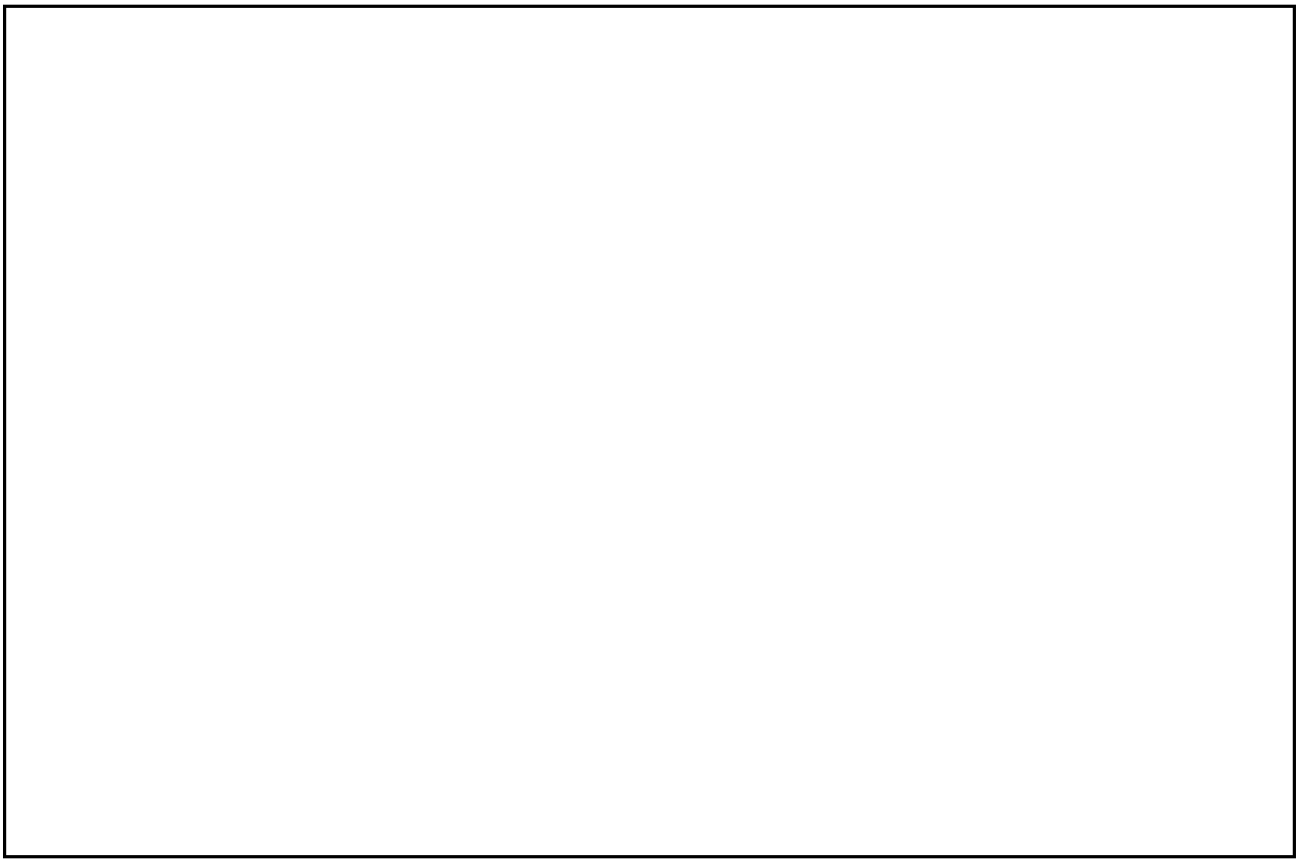
D. Status of Fund Expenditures to End of Monthly Period

Funds expended at break-even level to 26 September 1965:

July	
August	
September	

25X1

25X1



E. Documentation of Verbal Commitments and/or Agreements During the Period

Wherever possible, Edge-GEMS will be employed in initial evaluations of the photographic and electronic processing systems.

25X1 [redacted]

ELECTROPHOTOGRAPHIC PROCESSING TECHNIQUES

25X1 CONTRACT [redacted] TASK ORDER NO. 05(100,762)05-8

Monthly Narrative Report - October 1965

This is the fourth of a series of monthly narrative reports on a study of electrophotographic processing techniques. The study comprises the investigation and development of photographic and electronic techniques for processing photographic images. This report covers the work performed by the [redacted] 25X1
25X1 [redacted] during the period from 22 September to 22 October 1965.

A. Current Status of Work

1. Photographic Processing

The key to photographic processing will be control of acutance and granularity in processed transparencies by adjustment of density thresholds, expansion and contraction of densities, and variation of the illuminating spot from a modulated-light printing source. The feasibility of these photographic techniques has been demonstrated to a limited extent with specific images. An important objective of the current program is the development of these and related techniques for processing photographic images in general. With the view towards improving photographic image perceptibility, an orderly schedule of analysis and experimentation is being pursued.

Prior to the start of this investigation, it was determined that special test equipment would be required. In addition, calibration of this equipment, to reproduce experimental results and properly relate the findings to relevant efforts, must be performed. Almost all of the special test equipment required for photographic processing has been received and installed in a new photographic laboratory. The calibration phase of the study,

which has occupied much of the effort to date, is nearly complete.

A basic element of the proposed photographic processing system is an experimental modulated-light contact printer, which is now under final development. By employing negative feedback, this electronic printer will effect large-area contrast compression as a first step in the processing of transparencies. All the electronic components have been assembled on a standard equipment rack; however, delays in the fabrication of mechanical parts to attach to a drill press column have been experienced. Construction of this item is planned for completion during the next monthly period.

In addition to these tasks, preliminary selection of films for
25X1 use with the [redacted] high-resolution contact printer, another element of the photographic processing system, has been made. The selected films comprise SO 3404, SO 5427, SO 2427, SO 278, Gravure and Ortho Type 3, all Eastman Kodak products. Also, film chip number 5, one of a set of chips supplied by the Technical Representative of the Contracting Officer, was experimentally programmed for density plotting by the isodensitracer. The results will help establish the location of density components to be modified for image sharpness.

Concurrent with these efforts, a review of GEMS and Edge-GEMS for application to this program is being performed.

2. Electronic Processing

The key to electronic processing, analogous to photographic processing, will be separate and simultaneous operation on the high and low frequency information in photographic images. Development of a breadboard high-resolution electronic processing system for improving photographic image perceptibility is based upon pursuit of an orderly schedule of analysis and experimentation.

A preliminary analysis led to the design, construction and assembly of breadboard equipment to evaluate critical aspects and demonstrate operating principles of a proposed two-kinescope

processing system. Experiments with this equipment provided satisfactory resolution of the problems of achieving system stability with a wideband, high-gain feedback system; and of achieving high system signal-to-noise ratios when unexposed films (along with given transparencies) are placed in the light path of the sensor.

Feasibility of the proposed system having been demonstrated, the design of electronic filters for the feedback loop of the breadboard high-resolution electronic processing system was begun. At present, the system incorporates (equivalent) registered negative and positive light masks for photographic images. Introduction of the electronic filters will permit separate operation on the high and low frequency information.

The present equipment employs standard kinescopes and unidirectional scan by the kinescopes' electron beams. The breadboard high-resolution system will employ a high-resolution kinescope (as a source of modulated light), which has been ordered, and box-type (triangular horizontal and vertical) scan by the beams. Equipment to produce box scanning, whose feasibility was demonstrated during a previous study completed in 1964, is now under evaluation; final specification will be made at the start of the next monthly period.

Concurrent with these efforts, the investigation and the evaluation of other electronic techniques are continuing in light of the overall program objectives.

B. Problem Areas Encountered

1. Photographic Processing

25X1

a. The [redacted] sensitometer still has not been delivered; it is now expected to arrive in early-November. This item is not critical to the performance of projected tasks for the next monthly period; however, efforts to speed-up delivery of this item are still being pursued.

b. Unanticipated delays in the fabrication of parts, delays resulting from the huge backlog of machine shop orders, are affecting the schedule for construction of

the modulated-light contact printer. Delivery of this experimental equipment to the photographic laboratory is now planned for 17 November; the schedule of tasks has been revised accordingly.

2. Electronic Processing

A review of the breadboard electronic processing equipment requirements, in light of the overall program objectives, has led to an investigation of a new [redacted] deflection yoke driver. This dual-driver [redacted] Model No. RDAPP6NIR) can drive two yokes and operate at frequencies as high as 22 KHz; previously approved equipment cannot operate at frequencies greater than 10-13 KHz. Preliminary indications are that this new driver is more compatible with the system resolution (greater than 25 cycles/mm) and format (2" x 2") goals. 25X1 25X1

C. Projected Work for Next Monthly Period

1. Photographic Processing

a. Perform calibration of the microcopier.

b. Incorporate the microcopier in the film characteristics measurements program.

c. Complete construction of the modulated-light contact printer.

d. Perform calibration of the modulated-light contact printer.

e. Review proposed photographic processing techniques with respect to repeatability of density reproduction.

2. Electronic Processing

a. Continue design of the electronic filters for the feedback loop of the breadboard high-resolution electronic processing system.

b. Continue investigation and evaluation of electronic techniques in light of the overall program objectives.

D. Status of Fund Expenditures to End of Monthly Period

Funds expended at break-even level to 24 October 1965:

25X1

E. Documentation of Verbal Commitments and/or Agreements During the Period

No special verbal commitments nor agreements were made during the period.

25X1 [redacted]

ELECTROPHOTOGRAPHIC PROCESSING TECHNIQUES

25X1 CONTRACT [redacted] TASK ORDER NO. 03(100.762)65-R

Monthly Narrative Report - December 1965

This is the sixth of a series of monthly narrative reports on a study of electrophotographic processing techniques. The study comprises the investigation and development of electrical-chemical and electronic techniques for processing photographic 25X1 images so as to improve their perceptibility to human observers. This report covers the work performed by the [redacted] 25X1 [redacted] during the period from 22 November to 22 December 1965.

The key to the electrical-chemical processing is control of acutance and granularity in processed transparencies by adjustment of density thresholds, expansion and contraction of densities, and application of modulated-light contact printing. The key to the electronic processing, both analogous and complementary to the electrical-chemical processing, is separate and simultaneous operation on the high and low frequency information in the photographic images.

A. Current Status of Work

1. Electrical-Chemical Processing

25X1 The [redacted] copy camera was calibrated for photo-reduction factors of 10:1 and 7:1 with a 12-inch focal length [redacted] lens. 25X1 The camera was also calibrated for reductions of 7:1 and 4:1 with a 25X1 9.5-inch [redacted] lens.

Preliminary testing and calibration of the modulated-light contact printer were begun. The equipment was operated in the unmodulated mode to determine cathode ray tube light uniformity and equivalent density uniformities for several types of film, resolution limits by monoscope-target (10 to approximately 300 cycles/mm) replication, and density properties by step-tablet (21, 36 and 64 step) reproduction.

The printer was also operated in the modulated mode to determine cathode ray tube illumination properties and equivalent density figures for several types of film. These tests revealed equipment faults which must be corrected.

The transparency incorporating simple geometrical shapes and a scene-chip area was prepared. Reproduction of the composite image in states representing known degrees of defocus, over-exposure, and smear or motion (to provide a set of test targets for initial processing experiments) was nearly completed.

2. Electronic Processing

The investigation of light non-uniformity in the bread-board electronic processing system was continued. The dual glass condensers which replaced the Fresnel lens in front of the photo-multiplier produced better uniformity but higher attenuation of the blue light. Thus, a required tradeoff between picture quality and signal-to-noise ratio was indicated.

Electronic edge enhancement (the placing of narrow white borders on black objects or narrow black borders on white objects) using a variable delay line to simulate differentiation was demonstrated to the Technical Representative. The technique holds promise for increasing edge contrast without seriously affecting large-area contrast. Further evaluation awaits the delivery and installation of isotropic-scan equipment.

Attendance at the M.I.T. Industrial Liaison Symposium entitled "Sensing, Analyzing and Processing Visual Information" acquainted project personnel with imaging devices being developed at M.I.T. None of the seven papers presented was directly related to the current study efforts.

B. Problem Areas Encountered

Preliminary testing and calibration of the modulated-light contact printer revealed two faults which must be corrected. Cross-hatching or banding in the cathode ray tube printing raster may be due to electrical noise in the video feedback loop. Also, the light modulation resulting from negative feedback is inadequate for replication purposes; in this case the light-pickup sensitivity may be too low. These two limitations on performance will be investigated further during the next monthly period.

C. Projected Work for Next Monthly Period

1. Electrical-Chemical Processing

a. Complete preparation of test targets for initial processing experiments.

b. Modify modulated-light contact printer as required.

c. Continue testing and calibration of modulated-light contact printer.

d. Begin processing experiments with degraded test targets (a).

2. Electronic Processing

a. Continue processing experiments with preliminary breadboard electronic image-processing system.

b. Anticipate delivery of the special [redacted] deflection yoke driver and the high-resolution Ferranti cathode ray tubes. 25X1

c. Upon receipt of the driver and tubes (b), begin construction of the final breadboard system.

In addition to the above, an analysis of the techniques--centered about the modulated-light printing sources--will be started during the next period.

D. Status of Fund Expenditures to End of Monthly Period

Funds expended (and committed) at break-even level to 31 December 1965:

25X1

E. Documentation of Verbal Commitments and/or Agreements During the Period

25X1 Under this task order, [redacted] must investigate the feasibility of applying modulated-light techniques to rear projection viewing. At their meeting with the Technical Representative on 13 December, project personnel agreed to prepare an informal proposal for a 3-month sub-study in this area. This proposal should be forwarded to and evaluated by the Technical Representative as soon as possible.

25X1

ELECTROPHOTOGRAPHIC PROCESSING TECHNIQUES

25X1 CONTRACT [redacted] TASK ORDER NO. 03(100,762)65-R

Monthly Narrative Report - January 1966

This is the seventh of a series of monthly narrative reports on a study of electrophotographic processing techniques. The study comprises the investigation and development of electrical-chemical and electronic techniques for processing photographic images so as to improve their perceptibility to human observers. This report covers the work performed by the [redacted] 25X1

25X1 [redacted] during the period from 22 December 1965 to 22 January 1966.

The key to the electrical-chemical processing is control of acutance and granularity in processed transparencies by adjustment of density thresholds, expansion and contraction of densities, and application of modulated-light contact printing. The key to the electronic processing, both analogous and complementary to the electrical-chemical processing, is separate and simultaneous operation on the high and low frequency information in the photographic images.

A. Current Status of Work

1. Electrical-Chemical Processing

Preparation of the degraded test targets for initial processing experiments was completed. Each transparency is a composite image containing an array of density-segmented triangles and a scene, both subjected to a known degree of defocus, over-exposure or smear. Corrective replication of the defocussed samples has begun using masking, composites requiring precise registration, and diffraction systems. The initial processing experiments cited above employ photo-masking (manual dodging) techniques which are complicated and time-consuming. Upon its availability, the automatic dodging and modulated-light printer will be incorporated into the corrective replication cycle.

The debugging of the breadboard modulated-light contact printer continued during the monthly period. Several electrical and optical modifications were made to improve the performance of the equipment. Completion of this task is anticipated for early in the next monthly period.

2. Electronic Processing

Final experiments were performed with the low-resolution breadboard electronic processing system. Scene images and test samples (i.e., the composite images prepared in the photographic laboratory) were processed to record the performance of the equipment prior to its disassembly. When this task was completed,

construction of the high-resolution breadboard system was begun.

A full analysis and evaluation of the experimental results will be performed during the next monthly period. Initial indications are that image perceptibility was improved by electronic processing. However, sharpened edges exhibited overshoots which must be studied. Also, the masking resolution appeared to be lower than estimated from the original mathematical model of the system.

Further theoretical analysis of modulated-light techniques, centered about a mathematical model of modulated-light contact reproduction (printing and viewing) systems, was therefore begun. The analysis is being made in terms of the line spread functions and spatial frequency responses of the system elements (e.g., original transparency, kinescope beam spots, and electronic feedback circuits). Under this task, experimental and analytical results will be correlated.

B. Problem Areas Encountered

No new major problem areas were encountered during the monthly period.

C. Projected Work for Next Monthly Period

1. Electrical-Chemical Processing

a. Complete corrective replication of degraded test targets.*

b. Analyze and evaluate processed images (a) with respect to degraded and original samples.*

c. Determine performance characteristics of modulated-light contact printer, and calibrate equipment.

d. Perform corrective replication of degraded test targets with modulated-light contact printer.**

e. Select and evaluate typical scene images for processing.

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*Discussions with the customer subsequent to the end of this reporting period indicated that the corrective replication of the degraded targets using the time consuming photocopy techniques alone should be curtailed. Hence, this processing is being stopped midway through the next month and the analysis and evaluation performed only for the limited processing.

**During the same discussions (as in *), the customer indicated that the further processing experiments should concentrate on the scenes (1.e) rather than the targets. This is the current plan.

2. Electronic Processing

a. Begin construction of high-resolution breadboard processing system.

b. Analyze and evaluate results of final processing experiments with low-resolution breadboard system.

c. Continue theoretical analysis of modulated-light contact reproduction (printing and viewing) systems.

d. Correlate experimental and analytical results.

D. Status of Fund Expenditures to End of Monthly Period

Funds expended (and committed) at break-even level to 30 January 1966:

25X1

	Month	Cumulation

E. Documentation of Verbal Commitments and/or Agreements During the Period

No special verbal commitments or agreements were made during the period.

25X1

[redacted]

ELECTROPHOTOGRAPHIC PROCESSING TECHNIQUES

25X1 CONTRACT [redacted] TASK ORDER NO. 03(100,762)65-R

Monthly Narrative Report - February 1966

(Covering the period January 22, to February 22, 1966)

A. Current Status of Work

1. Electrical-Chemical Processing

Further corrective processing experiments employing photo masking techniques were conducted on the defocussed version of the specially-prepared composite transparency (density-segmented triangle array plus scene). However, as requested by the customer on February 8, 1966, further processing of these degraded transparencies using the time consuming photo copy techniques was stopped after that date. Processing was to concentrate henceforth on real imagery, such as available on the AFSPPL Film, Mission No. 40-09112, and using more advanced experimental techniques, e.g., modulated light, chemical, and spatial filtering. However, measurements were made of the results of partial correction on the defocussed transparency and comparisons made with measurements for the undegraded standard and the original defocussed transparencies. Analyses were made to determine the effect of the partial processing and the types of further processing needed.

From the AFSPPL Film, Mission No. 40-09112, frame number 46574 was selected for the initial phase of qualification of real images. Two types of images were selected: 1) a bar target and 2) an aircraft. The bar target consists of two density steps and contains image elements that are above and below the liminal (threshold) level. On the aircraft wing is a sub-liminal service designation whose recognition shall be a goal of the processing. The image consists of three density levels, (the service designation,

the wing, and the ground behind the wing. Actual image element dimensions are from 5 microns to 250 microns. These images have been enlarged from between 50 and 500 diameters by means of a phase contrast microscope. At these enlarged levels, it is possible to relate the CRT spot size to the image incremental element size for the density manipulation program. Micro densitometer traces have been made of the original scene area and the enlargements.

Debugging continued on the CRT modulated light printer. Several modifications were made to the printer which enabled preliminary tests to be made with it. Primary emphasis was to determine the uniformity of printing densities during the modulated and unmodulated modes. Low, medium, and high density levels, as well as zero, 50% and 100% modulation were the preliminary test points. However, certain faults were still noted in the printer outputs, e.g., cross-hatching and banding, and changes are now being made to attempt to correct these faults.

2. Electronic Processing

Final samples of transparencies processed with negative masking through the low resolution electronic processor were prepared and shown to the customer on February 8, 1966, to compare with transparencies prepared through the system with unmodulated light. At his request, enlarged positive copies of these transparencies as well as copies from the original negatives have been prepared for his examination.

On February 4, the low resolution electronic processing system was disassembled to start construction of the high resolution system. All [redacted] components have been received except the [redacted] mumetal shields for the two kinescopes. They are promised by March 1. 25X1 25X1

Work is continuing on assembling and wiring the high resolution system on the aluminum bedplate.

3. Techniques Analysis

A mathematical model of modulated-light contact reproduction systems has been formulated. With appropriate interpretation of terms, the model attempts to describe the operation of the breadboard cathode-ray-tube printer, the low and high resolution breadboard electronic processing systems, and also the prototype film viewing tables. The model incorporates the line spread functions and spatial frequency responses of the major system elements: the original transparency, the kinescope beams, and the feedback circuits. Secondary system elements (e.g., lenses) are not included in this preliminary model.

With respect to the space domain, the line spread function of the contact image (i.e., the image reproduced by contact printing or viewing) is shown to be the difference between an unmodulated spread function (proportional to the spread function of the original transparency) and a modulated spread function. Correspondingly, the spatial frequency response of the contact image is shown to be the difference between an unmodulated frequency response (proportional to the frequency response of the original transparency) and a modulated frequency response.

Several tests of the model are being performed before it is incorporated fully in the techniques analysis. Specifically, the ability of the model to satisfactorily predict known phenomena such as low-frequency suppression and image erasure is being determined.

B. Problem Areas Encountered

Difficulties with the CRT modulated light printer have not made it possible to utilize this equipment yet in actual processing experiments. A concentrated effort is being made to make the necessary engineering corrections to this device. A hold was placed, at the customer's request, on the purchase of a dichroic mirror and a 2000 volt power supply for the high resolution electronic processor. This delay in purchase of these items will delay completion of the processor.

C. Projected Work for Next Month

1. Electro-Chemical Processing

a. Select images located in the sub-liminal region.

1) Associate the number of density steps in respect to the number of detail elements of the image.

2) Enlarge, adjust densities, fill in inter-space among density grains.

3) Measure density/intensity on Richards viewer.

b. Complete corrections on modulated-light printer and calibrate and evaluate printer (using target supplied by customer).

2. Electronic Processing

a. Complete construction of high resolution electronic processor

b. Calibrate and adjust processor

3. Techniques Analysis

a. Complete check out tests of mathematical model and analyze results.

b. Use model to analyze results of final processing with low-resolution electronic processor, specifically the microdensitometer traces of triangle edges.

4. Prepare Second Interim Report

D. Status of Fund Expenditures to End of Month

Funds expended (and committed) at break even level to 27 February 1966, are shown below along with a proportional share of the base fee: 25X1

	Break-Even Level	Fee	Sell Level

E. Documentation of Verbal Commitments and/or Agreement During the Period

A meeting was held with the customer on February 8, 1966 reviewing the financial and technical status of the EPT program. Several agreements were made at that time and documented in minutes of that meeting which have been transmitted to the customer. The key items were:

25X1 1. [ ] is not to take any action with regard to the following activities until directed to do so by the customer.

a) Rear Projection Viewer Study

b) Use of Photo Interpreter Consultants

c) Spatial Frequency Analyzer Development

25X1 2. [ ] was to supply a detailed listing of program costs broken down by task indicating personnel assignments (This was delivered on Feb. 23, 1966).

25X1 3. [ ] is to concentrate on processing of operational-type transparencies rather than artificially generated scenes.

4. The customer would supply a resolution target to measure the capability of the contact printer (supplied on February 25, 1966).

25X1 5. [ ] will provide positives of samples of the inputs to and the results of unmodulated and modulated processing by the low resolution breadboard electronic processor.

25X1

[redacted]

ELECTROPHOTOGRAPHIC PROCESSING TECHNIQUES

25X1 CONTRACT [redacted] TASK ORDER NO. 03(100,762)65-R

Monthly Narrative Report - March 1966
(Covering the period February 23 to March 22, 1966)

A. Current Status of Work

1. Second Interim Technical Report

The preparation of the Second Interim Technical Report took place during this monthly period. Drafts of all the sections of the report were completed. Editing and publication of the report will be finished during the next monthly period.

2. Electrical-Chemical Processing

With respect to real imagery processing, further use was made of a phase contrast microscope to increase the recognizability of the bar target and the aircraft markings in Frame number 46572 of the 5 inch AFSPPL film. An increase in contrast and new density limits were obtained using the microscope's phase-amplitude modification capabilities. This resulted in considerably improved images.

Preliminary use was also made of the [redacted] "L" Target Resolution 25X1
Standard supplied by the customer. Preliminary tests were made on the [redacted] 25X1
25X1 [redacted] printer to determine the maximum printing resolution for SO278 and 3404 films. Determination of maximum resolution capability requires further testing with critical exposure and chemical processing controls.

Further modifications were made to the CRT modulated light printer. Circuitry changes in the feedback loop and the replacement of a regulated power supply were the major changes. Additional debugging took place in order

to reduce system noise and properly adjust the gains of the system components. It is believed that the major problems have been determined and mostly corrected and that full testing of the printer will be able to take place during the coming month.

3. Electronic Processing

The assembly and wiring of the high resolution breadboard processor has been almost completed and should be finished by the end of March.

4. Processing Techniques Analysis

The ability of the analytical model of modulated light systems to satisfactorily predict known phenomena such as space-domain overshoot, low-frequency suppression, and image erasure was investigated. Sample calculations were made based upon assumed Gaussian LSF's and MTF's for the film and kinescope spots; the feedback chain was assumed to be perfect. By the end of the monthly period, space-domain overshoot and low-frequency suppression were observed analytically. The image erasure analysis was not concluded.

B. Problem Areas Encountered

No new problem areas were encountered this month. However, the engineering modifications to the breadboard contact printer were not completed in time for tests and subsequent use of the printer during the past month.

C. Projected Work for Next Month

1. Electrical-Chemical Processing

a. Complete modification and debugging of modulated-light CRT printer.

b. Test CRT printer capability (in modulated and unmodulated mode) with respect to uniformity of illumination, density duplication and modification, resolution, and alternate operational sequences.

c. Use CRT printer in image improvements program for selected photographic scenes (from AFSPPL film and others).

2. Electronic Processing

a. Complete all wiring on high resolution electronic processor.

b. Test and adjust the system as necessary.

c. Make measurements of contact and masking resolution of the system.

d. Start printing experiments, in particular, by repeating those experiments previously conducted with the low-resolution breadboard.

3. Techniques Analysis

a. Complete check out tests of model.

b. Apply model, if possible, to analyze results of processing with the low-resolution electronic processor, a film viewing table, and the CRT contact printer.

D. Status of Fund Expenditures to End of Month

Funds expended (and committed) at break even level to March 27, 1966, are shown below along with a proportional share of the base fee:

25X1

E. Documentation of Verbal Commitments and/or Agreements During the Period

At a meeting in Washington, February 23, 1966, [redacted] was given verbal permission to proceed with the purchase of the dichroic mirror and the 2000 volt power supply it had requested for the high resolution electronic processor.

25X1